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ABSTRACT

Two-column objectives are listed for an integrated science curriculum (grades K-12), often subheaded according to science area (biology, general science, physical science) and grade level. The focus of grades K-6 is an acquaintance of the student to: (1) the study of matter, its states, characteristics and properties, (2) structure of the atom, and (3) transformation of matter. Grade 7 interrelates topics of the nitrogen cycle, resource conservation, biological control, and photosynthesis. Grades 8-11 contain purely physical science objectives. Grade 11 relates chemistry and physics to the study of living things by grouping objectives for studying atomic structure, biochemical models, and enzyme-substrate reactions. (CS)

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SCIENCE

K - 12

CONSERVATION OF MATTER

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ARTICULATED CURRICULUM

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MRS. ROSE DANELLA and NORMAN I. SIEGEL, both former Board Members deserve special mention for all their efforts on behalf of Project SEARCH.

UTICA CITY SCHOOL DISTRICT
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Utica, New York 13501

SCIENCE

CONSERVATION OF MATTER

The student will know:	The student will:
- that there are many sizes and shapes of all living and non-living things.	- orally list large, medium, and small living and living things.
- that moving things, people and animals make sounds.	- identify sounds made by a selection of moving t
- that there are three states of matter.	- list the three states of matter orally. (solid gas).
- that all things are composed of matter.	- identify the composition of a variety of materi
- that forms of energy-sound, heat, and light-affect matter.	- list several things that are changed by heat, l sound.
- that our world is made of many kinds of matter.	- identify a gas, liquid, solid.
- that matter has three states-solid, liquid gas.	= classify matter from a given list. i.e. hard, s
- that solids have definite volume and shape; liquids have volume but take shape of container; gases have no volume or shape.	- categorize materials as solids, liquids and gas determine which have volume and shape.
- that many kinds of matter can be grouped into "families" i.e. wood, metal, etc.	- orally define necessary terms.

CONSERVATION OF MATTER

Grade K

The student will:

and shapes of all ...gs.
- orally list large, medium, and small living and non-living things.

... and animals make
- identify sounds made by a selection of moving things.

...s of matter.
- list the three states of matter orally. (solid, liquid, gas).

Grade 1

...ed of matter.
- identify the composition of a variety of materials.

..., heat, and light-
- list several things that are changed by heat, light, and sound.

Grade 2

...many kinds of
- identify a gas, liquid, solid.

...s-solid, liquid
- classify matter from a given list. i.e. hard, soft.

...volume and shape; ...e shape of con-...e or shape.
- categorize materials as solids, liquids and gases, and determine which have volume and shape.

...an be grouped ... metal, etc.
- orally define necessary terms.

- that matter is anything that has weight and occupies space.	- define matter in writing.
- that matter may be classified in terms of properties.	- make charts classifying objects according to the properties.
- that matter can change from one form to another.	- identify how matter can change from one form to e.g. melt ice, boil water, freeze water.
- that matter is made up of molecules and atoms.	- classify matter according to its state.
- that light, heat and sound affect the motion of molecules in matter.	- perform an experiment showing how matter can ch one form to another. (e.g. melt ice, boil water water).
- that in chemical change, atoms react to produce change in the molecules.	- chart 3 forms of matter and explain each.
- that matter exists as solids, liquids and gases.	- define the nature of matter as it exists in a s liquid, and a gas.
- that matter is made of particles and that matter can be changed from one form to another.	- write a definition for matter indicating that i of particles and may be changed from one form t
- the three basic states of matter-solid, liquid, and gas.	- classify materials under each heading.
- that in chemical or physical changes, the total amount of matter remains unchanged.	- list changes that occur when performing experim
- the characteristics of matter: cannot be destroyed, cannot be created, and can be changed into energy.	- define the characteristics of matter indicating cannot be destroyed, created, or changed into e

Grade 3

at has weight and	- define matter in writing.
ied in terms of	- make charts classifying objects according to their physical properties.
m one form to	- identify how matter can change from one form to another, e.g. melt ice, boil water, freeze water.

Grade 4

molecules and atoms.	- classify matter according to its state.
affect the motion of	- perform an experiment showing how matter can change from one form to another. (e.g. melt ice, boil water, freeze water).
toms react to ecules.	- chart 3 forms of matter and explain each.
ids, liquids	- define the nature of matter as it exists in a solid, a liquid, and a gas.

Grade 5

rticles and that one form to	- write a definition for matter indicating that it is made of particles and may be changed from one form to another.
matter-solid,	- classify materials under each heading.
cal changes, the mains unchanged.	- list changes that occur when performing experiments.
tter: cannot be ted, and can be	- define the characteristics of matter indicating that matter cannot be destroyed, created, or changed into energy.

- that our conservation of matter will affect future generations.	- report on how waste of matter could affect futu
- the states of matter.	- lescribe three different states of at least fiv stances.
- the properties of matter.	- define the properties of matter e.g. inertia, m volume, porosity.
- the make-up of matter.	- describe the structure of an atom, with a simpl
- the names and data of the 15 most commonly occuring elements.	- list the names and data of the 15 most commonly elements.
- the make-up of a variety of compounds.	- when given formulas for a variety of compounds, elements found in each.
- the transformation of matter.	- describe the manner in which matter may be chan one form to another without ary loss or gain po
General Science	
- the function of the nitrogen cycle.	- diagram and label the nitrogen cycle.
- the phases of mitosis.	- list the phases of mitosis .
	- explain orally the occurances in each phase.
	- diagram and label the phases of mitosos.
- that the need for conservation of our resources is vital to man's survival.	- define exploitation.
	- describe factors leading to the exploitation of plant, and wild life, and air.
	- define conservation.

tter will affect — report on how waste of matter could affect future generations.

Grade 6

- describe three different states of at least five substances.
- define the properties of matter e.g. inertia, mass, density, volume, porosity.
- describe the structure of an atom, with a simple illustration.

15 most — list the names and data of the 15 most commonly occuring elements.

compounds. — when given formulas for a variety of compounds, state the elements found in each.

r. — describe the manner in which matter may be changed from one form to another without any loss or gain possible.

Grade 7

ral Science

n cycle. — diagram and label the nitrogen cycle.

- list the phases of mitosis .
- explain orally the occurances in each phase.

diagram and label the phases of mitosos.

ion of our survival. — define exploitation.

- describe factors leading to the exploitation of soil, water, plant, and wild life, and air.
- define conservation.

	- define ecology.
- that there are 4 major areas of conservation.	- list the 4 major areas: water, soil, and wildli
	- list various reasons why there is a need for co in each of these areas - the importance of each
- that a watershed is a natural ecological unit which should be controlled for a number of reasons	- define the following terms: runoff, watershed, erosion.
	- describe the damage created by uncontrolled wat relation to flooding, loss of crops, loss of to using the Mississippi Valley, the largest water U.S. as a premise.
	- describe various methods of controlling watersh as the use of dams and dikes.
	- be able to list and describe the following form erosion: wind, sheet, stream-bank, and gullies
- that soil conservation goes hand in hand with sound methods of utilizing soil, (farming).	- compare farming methods of the past with those and describe changes that have been made to emp of soil conservation.
	- define the following terms: contour, plowing, covercrops, crop rotation, fertilizer.
- that biological control of environmental pests is often necessary to keep nature in balance with man's changing world.	- define the following terms: pest, pesticide, i fungicide.
- that there are several different types of chemical additives in our environments which help us control pests - some good and some bad.	- draw and describe the DDT cycle.
	- give reasons why chemicals should not be added environment until we understand their full effe
- why forests make up one of our most valuable resources.	- list factors leading to the necessity of forest trees, i.e., lumber, paper, pulp, homes for ani recreation.

- define ecology.

of

- list the 4 major areas: water, soil, and wildlife & forests.

- list various reasons why there is a need for conservation in each of these areas - the importance of each to mankind.

l ecological
led for a

- define the following terms: runoff, watershed, water table erosion.

- describe the damage created by uncontrolled watersheds in relation to flooding, loss of crops, loss of top soil, etc. using the Mississippi Valley, the largest watershed in the U.S. as a premise.

- describe various methods of controlling watersheds, such as the use of dams and dikes.

- be able to list and describe the following forms of soil erosion: wind, sheet, stream-bank, and gullies and rills.

hand in hand
ing soil.

- compare farming methods of the past with those now in use and describe changes that have been made to employ methods of soil conservation.

- define the following terms: contour, plowing, terracing, covercrops, crop rotation, fertilizer.

nvironmental
keep nature in
world.

- define the following terms: pest, pesticide, insecticide, fungicide.

rent types of
vironments
some

- draw and describe the DDT cycle.

- give reasons why chemicals should not be added to our environment until we understand their full effect.

r most

- list factors leading to the necessity of forests and trees, i.e., lumber, paper, pulp, homes for animals, recreation.

- what methods of conservation are being employed to preserve timber.	- describe legislation which prohibits lumbering areas. - list methods of thinning out our forests, i.e., weak members of a species, logging only a small of trees per acre. - list various tree diseases caused by insects an are controlled.
- the mechanism by which plants convert are form of matter to another form of matter, utilizing the sun's energy to form chemical hands.	- define the following: atom, proton, electron, neutron, molecule, comp chemical hand matter, energy. - list the compounds utilized by plants in the ph process. - list the compounds formed in photosynthesis. - write a balanced molecular equation for photosy - construct a relationship from the photosynthet sharing that matter was nutrilized created not in this process but simply changed its form.
- that we use physical and chemical properties in the identification of materials.	- perform the flame test which constitutes a phys of identifying metals. - by dipping a clean platinum loop into a salt co particular mettalic ion he will observe the col flame produced. With the use of a spectroscope acteristic spectrum may be identified.
- the simplest substances obtainable are called elements.	- decompose sugar to discover the elements found compound. By heating sugar in a test tube the breaks down into carbon and another compound wa carbon is first identified before burning in air

n are being
.

- describe legislation which prohibits lumbering in particular areas.

- list methods of thinning out our forests, i.e., removing weak members of a species, logging only a small percentage of trees per acre.

- list various tree diseases caused by insects and how they are controlled.

ts convert are
orm of matter,
to form

- define the following:
atom, proton, electron, neutron, molecule, compound, chemical hand matter, energy.

- list the compounds utilized by plants in the photosynthesis process.

- list the compounds formed in photosynthesis.

- write a balanced molecular equation for photosynthesis.

- construct a relationship from the photosynthetic equation sharing that matter was nutrilized created not destroyed in this process but simply changed its form.

Grade 8

emical proper-
of materials.

- perform the flame test which constitutes a physical method of identifying metals.

- by dipping a clean platinum loop into a salt containing a particular mettalic ion he will observe the color of the flame produced. With the use of a spectroscope a characteristic spectrum may be identified.

inable are

- decompose sugar to discover the elements found in the compound. By heating sugar in a test tube the sugar breaks down into carbon and another compound water. The carbon is first identified before burning in air.

- that matter exists as three forms or states solids, liquids, and gases.

- that energy is always involved when a substance changes from one state to another.

- mixtures are complex substances and not a single substance.

- matter is particulate and not continuous.

- atoms collide and stay together forming bonds which hold these atoms together as molecules.

- the visible gas is bubbled through limewater
as the compound carbon dioxide when the limew
milky. The water produced by heating sugar i
cobalt chloride paper which changes from blue
color.

- demonstrate the breakdown products of water c
electrolysis experiment. The two gases, oxy
hydrogen may be easily identified by testing
splint and a flaming splint.

- demonstrate the three forms of matter by heat
ice to change the solid water to liquid water
heating the water to change the liquid water
water vapor.

- plot a graph using temperature as a function
heating the ice and water in the experiment a
observing the plateaus at the boiling point a
point the energy change at the phase or change
is discovered.

- seperate a solution of salt and water by heati
solution in an evaporating dish to remove the
then to observe the residue which remains.

- look at newspaper clippings to discover the va
of grey and black using a hand lens to see the
individual particles which compose the picture

- perform a demonstration to show how the partic
hydrochloric acid combine with the particles f
ammonium chloride to form a solid substance am
chloride. He will take each of these liquids
to seperate corks and place the corks into an
of large glass tubing. A white cloud of ammon
forms as the two gases collide to form a white
tube.

- the visible gas is bubbled through limewater to identify it as the compound carbon dioxide when the limewater turns milky. The water produced by heating sugar is tested with cobalt chloride paper which changes from blue color to red color.

- demonstrate the breakdown products of water carrying out an electrolysis experiment. The two gases, oxygen and hydrogen may be easily identified by testing with a glowing splint and a flaming splint.

ee forms or states
s.

- demonstrate the three forms of matter by heating a piece of ice to change the solid water to liquid water. Continue heating the water to change the liquid water to gaseous water vapor.

olved when a
e state to

- plot a graph using temperature as a function of time when heating the ice and water in the experiment above. By observing the plateaus at the boiling point and freezing point the energy change at the phase or change of state is discovered.

tances and not

- seperate a solution of salt and water by heating the solution in an evaporating dish to remove the water and then to observe the residue which remains.

not continuous.

- look at newspaper clippings to discover the various shade of grey and black using a hand lens to see the tiny individual particles which compose the pictures.

gether forming
oms together

- perform a demonstration to show how the particles from hydrochloric acid combine with the particles from ammonium chloride to form a solid substance ammonium chloride. He will take each of these liquids add them to seperate corks and place the corks into an open piece of large glass tubing. A white cloud of ammonium chloride forms as the two gases collide to form a white ring in the tube.

- that extremely large numbers and extremely small numbers may be expressed by using exponentials to show their magnitude.

- list in writing the multiples and submultiples following expressions:

T=tera 10^{12}	M=micro 10^{-6}
G=giga 10^{9}	N=nano 10^{-9}
K=kilo 10^{3}	P=pico 10^{-10}
H=hecto 10^{2}	F=femto 10^{-15}
Da=deka 10^{1}	A=atto 10^{-18}
deci 10^{-1}	
C=centi 10^{-2}	
M=milli 10^{-3}	

- that matter is made up of molecules. Molecules are made up of atoms which are the smallest structural part of matter. Atoms are distinguished by their structure which is the smallest functional part of the elements.

- list the general physical properties of element

- distinguish between physical and chemical chang

- distinguish between elements, compounds, and mi

- identify a give sample of an element as metalli nonmetallic.

- the atom is made of smaller particles (the neutron, proton, electron) which are arranged in a definite pattern.

draw a simple diagram of an atom.

- list the characteristics (size, weight, charge of the 3 main particles that make up an atom.

- distinguish an atom by its atomic structure an it as an element.

- why any two elements may or may not react together.

- list elements according to atomic number.

- list the number of protons, neutrons, and elec each element.

- arrange electrons in orbits by the definite ar

- recognize an inert element.

rs and
y be expressed
how their

- list in writing the multiples and submultiples for the following expressions:

T=tera 10^{12}	M=micro 10^{-6}
G=giga 10^{9}	N=nano 10^{-9}
K=kilo 10^{3}	P=pico 10^{-10}
H=hecto 10^{2}	F=femto 10^{-15}
Da=deka 10^{1}	A=atto 10^{-18}
deci 10^{1}	
C=centi 10^{2}	
M=milli 10^{3}	

molecules.
atoms which
l part of
uished by
he smallest
ments.

- list the general physical properties of elements.
- distinguish between physical and chemical changes.
- distinguish between elements, compounds, and mixtures.
- identify a give sample of an element as metallic or nonmetallic.

r particles
ctron) which
pattern.

draw a simple diagram of an atom.

- list the characteristics (size, weight, charge and location) of the 3 main particles that make up an atom.
- distinguish an atom by its atomic structure and identify it as an element.

r may not react

- list elements according to atomic number.
- list the number of protons, neutrons, and electrons for each element.
- arrange electrons in orbits by the definite arrangement.
- recognize an inert element.

	- determine which elements will share electrons a stable.
- the periodic table is a functional chart of elements by atomic number, electron configuration, and chemical properties.	- identify families and periods of elements.
	- distinguish between metal and non-metal
	- list properties of families and which families which other families.
- atoms of elements combine in regular definite patterns.	- identify the components of simple molecular com
	- write the formula of simple compounds.
	- write a simple balanced equation.
- typical reactions of families of elements such as metal and nonmetal.	- identify by properties the elements which are m those that are nonmetals.
	- write balanced equations for the reaction betwe and nonmetal.
- reactions generally fall into specific catagories. A general equation can be written which would summarize all the examples in that category.	- describe composition reactions and write the ge equation to show this type of reaction.
	- describe decomposition reactions and write the equation to show this type of reaction.
	- describe the neutralization reaction and write equation to show this type of reaction.
	- perform one of each type of reaction.

Introductory to Physical Science

- that when matter undergoes a physical or chemical change, mass is conerved.	- measure volume of a substance by one of variou

	- determine which elements will share electrons and become stable.
nctional chart er, electron l properties.	- identify families and periods of elements. - distinguish between metal and non-metal - list properties of families and which families react with which other families.
in regular	- identify the components of simple molecular compounds. - write the formula of simple compounds. - write a simple balanced equation.
ies of elements .	- identify by properties the elements which are metals and those that are nonmetals. - write balanced equations for the reaction between a metal and nonmetal.
nto specific ation can be ize all the	- describe composition reactions and write the general equation to show this type of reaction. - describe decomposition reactions and write the general equation to show this type of reaction. - describe the neutralization reaction and write the general equation to show this type of reaction. - perform one of each type of reaction.

Grade 9

Physical Science

a physical or nerved.	- measure volume of a substance by one of various methods.

- establish a weight scale.

- measure the mass of a substance.

- demonstrate that mass is conserved when a phas
  a solid dissolves in a liquid, a chemical reac
  a preciptate.

- a chemical reaction produces a gas.

- two solids react chemically when heated.

- that characteristic properties of a substance can be used to distinguish one substance from another.

- determine the densities of solids, liquids, an

- determine the thermal expansion of solids, liq

- determine the elasticity of solids and gas.

- determine the freezing and melting points of s

- determine the boiling point of a liquid.

- determine the solubility of substances in vari
  and at various temperatures.

- read solubility graphs.

- demonstrate that the solubility of gases decre
  increase in temperature.

- that mixtures of pure substances can be seperated on the basis of their characteristic properties.

- separate a mixture of two liquids using fracti
  distillation.

- seperate an insoluble solid from a soluble sol
  filtration.

- separate a mixture of two soluble solids using
  crystallization.

- separate a mixture of soluble solids using pap
  chromatography.

- establish a weight scale.

- measure the mass of a substance.

- demonstrate that mass is conserved when a phase change occurs. a solid dissolves in a liquid, a chemical reaction produces a preciptate.

- a chemical reaction produces a gas.

- two solids react chemically when heated.

ies of a
stinguish

- determine the densities of solids, liquids, and gases.

- determine the thermal expansion of solids, liquids, and gases

- determine the elasticity of solids and gas.

- determine the freezing and melting points of substances.

- determine the boiling point of a liquid.

- determine the solubility of substances in various solvents and at various temperatures.

- read solubility graphs.

- demonstrate that the solubility of gases decreases with increase in temperature.

ances can be
heir character-

- separate a mixture of two liquids using fractional distillation.

- seperate an insoluble solid from a soluble solid using filtration.

- separate a mixture of two soluble solids using fractional crystallization.

- separate a mixture of soluble solids using paper chromatography.

- that when the end products of a separated mixture are physically combined, the original substance will be formed.

- that compounds can be separated by chemical means.

- that pure substances are classified as either elements or compounds.

- that matter is made up of tiny particles called atoms.

- combine the end products of the fractional dist paper chromatography experiments to obtain the mixtures.

- decompose a compound by means of heat.

- decompose a compound by means of electrolysis.

- analyze elements and compounds using flame test spectral analysis.

- observe the effect of radioactive substances on film Geiger counter, and cloud chamber.

Biology

- how a scientist conducts an investigation and the characteristics of the system he uses to make measurements.

- differentiate between a control group and an ex group.

- differentiate between a hypothesis and a theory

Physical Science

- that there are many forms of matter made up of various particles and differing in properties as well as in composition.

- be able to identify the various forms of matter example of each.

- catagorize the forms in terms of metals, non-me etc.

- the nature of atoms and molecules which make up the various forms of matter.

- be able to draw structures of both atoms and mo list the individual particles that make up the

- that all matter may undergo a chemical change as well as a physical change.

- give examples of both chemical change and physi matter and identify the resulting structures.

of a cally tance	- combine the end products of the fractional distillation or paper chromatography experiments to obtain the original mixtures.
ted by	- decompose a compound by means of heat.
	- decompose a compound by means of electrolysis.
ssified as .	- analyze elements and compounds using flame tests and spectral analysis.
ny particles	- observe the effect of radioactive substances on photographic film Geiger counter, and cloud chamber.

Grade 10

ogy

investigation he system he	- differentiate between a control group and an experimental group.
	- differentiate between a hypothesis and a theory.

Grade 10-11

cal Science

matter made up of ring in properties	- be able to identify the various forms of matter and give an example of each.
	- catagorize the forms in terms of metals, non-metals, gases, etc.
cules which matter.	- be able to draw structures of both atoms and molecules and list the individual particles that make up the structure.
a chemical change.	- give examples of both chemical change and physical change of matter and identify the resulting structures.

	- perform a simple experiment in which a chemical occurs and determine stoichiometrically how matt conserved.
	- be able to illustrate how it is possible to chan from one form to another.
- the various phases of matter and their relation to energy.	- calculate the volume of a gas such as hydrogen w will be required to form a given volume of ammon
- that equal volume of gases under the same conditions of temperature and pressure contain an equal number of particles.	- be able to interpret both the Boyle Law and the Law which apply to gases.
	- work out problems which apply to the Avagadro hy (ie; that there are 6.02×10^{23} particles in one m substance.
- that the mole concept applies to all forms of matter.	- be able to write and balance chemical equations.
	- show how the equations relate to the mole concep
	- calculate the gram atomic mass of elements and this to moles.
	- relate the situation to atomic mass and gram ato
- that the periodic table of the elements represents a periodic function of all the elements.	- construct the periodic table.
	- symbolize each element in its proper group.
	- organize a list of the elements so that they fal various catagories such as metals, non-metals, g
	- compare the properties of each group and unders behavior from the position they occupy in the pe table.
- the bonding types between atoms and their effect on structural forms.	- identify the various types of bonds.

- perform a simple experiment in which a chemical change occurs and determine stoichiometrically how matter is conserved.

- be able to illustrate how it is possible to change matter from one form to another.

er and their

- calculate the volume of a gas such as hydrogen which will be required to form a given volume of ammonia.

under the same
nd pressure
particles.

- be able to interpret both the Boyle Law and the Charles Law which apply to gases.

- work out problems which apply to the Avagadro hypothesis (ie; that there are 6.02×10^{23} particles in one mole of any substance.

les to all forms

- be able to write and balance chemical equations.

- show how the equations relate to the mole concept.

- calculate the gram atomic mass of elements and convert this to moles.

- relate the situation to atomic mass and gram atomic mass.

the elements
tion of all the

- construct the periodic table.

- symbolize each element in its proper group.

- organize a list of the elements so that they fall under various catagories such as metals, non-metals, gases, etc.

- compare the properties of each group and understand their behavior from the position they occupy in the periodic table.

toms and their

- identify the various types of bonds.

- a substance is a homogenous variety of matter all specimens of which have identical properties and composition.

- matter may exist in a solid, liquid or gaseous phase. A change in phase is accompanied by the absorption or release of energy.

- gases take the shape and volume of the container they occupy.

- liquids have a definite volume but no definite shape. They take the shape of the container they occupy.

- illustrate each type by a diagram.

- compare the physical properties of each type of

- be able to measure the ability of an element to electron.

- be able to use the electronegativity table to predict the nature of a bond.

- list general properties which can be used to id elements.

- list changes which indicate a chemical reaction

- identify by observation whether a compound or a formed when two elements are combined.

- identify and distinguish solids, liquids, and g

- read and interpret a phase change diagram.

- list values for standard temperature and pressu

- explain and calculate changes in gas volume usi Boyle's and Charle's Law.

- calculate the volume change of a gas using the gas laws.

- list the reasons the Ideal Gas Laws do not hold high pressures and low temperatures.

- list the properties of a gas under the Kinetic T Gases.

- describe the arrangement and motion of particles liquid.

- illustrate each type by a diagram.

- compare the physical properties of each type of bond.

- be able to measure the ability of an element to attract electron.

- be able to use the electronegativity table to predict the nature of a bond.

variety
which have
mposition.

- list general properties which can be used to identify elements.

- list changes which indicate a chemical reaction takes place. .

- identify by observation whether a compound or a mixture is formed when two elements are combined.

, liquid or
phase is
on or release

- identify and distinguish solids, liquids, and gases.

- read and interpret a phase change diagram.

- list values for standard temperature and pressure.

lume of the

- explain and calculate changes in gas volume using Boyle's and Charle's Law.

- calculate the volume change of a gas using the combined gas laws.

- list the reasons the Ideal Gas Laws do not hold true at high pressures and low temperatures.

- list the properties of a gas under the Kinetic Theory of Gases.

me but no
he shape of

- describe the arrangement and motion of particles in a liquid.

	- predict the affect of pressure on a liquid.
	- determine the heat of vaporization of a liquid.
	- identify the boiling point of a liquid from a va pressure graph.
- solids have a definite volume and shape.	- describe position and arrangement of particles i basic geometric solids.
	- define the melting point and determine its value various solids.
	- read and interpert a cooling curve on a graph.
	- calculate the heat of fusion of various solids.
- that energy may be converted from one form to another but is never destroyed, in a chemical reaction energy is either absorbed or released.	- list examples of the different forms of energy.
	- differentiate between exothermic and endothermic
	- apply the law of conservation of matter and ener chemical equations.
	- measure the change in the energy content of a ch reaction.
	- conver from Celsius to Kelvin temperature scale.
- that scientific experiments apparently support the particulate nature of matter: that all elements are composed of basic chemical units-atoms. The atoms themselves are structured.	- describe the fundamental properties of the elect proton, and neutron.
	- relate the mass number and atomic number to the of each atom.
	- list differences among the isotooes of a particu
	- write the symbol for the more common elements wi atomic number and mass number.

- predict the affect of pressure on a liquid.

- determine the heat of vaporization of a liquid.

- identify the boiling point of a liquid from a vapor pressure graph.

e and shape.

- describe position and arrangement of particles in the basic geometric solids.

- define the melting point and determine its value for various solids.

- read and interpert a cooling curve on a graph.

- calculate the heat of fusion of various solids.

from one
destroyed,
y is either

- list examples of the different forms of energy.

- differentiate between exothermic and endothermic reactions.

- apply the law of conservation of matter and energy to chemical equations.

- measure the change in the energy content of a chemical reaction.

- conver from Celsius to Kelvin temperature scale.

apparently
re of matter:
ed of basic
toms them-

- describe the fundamental properties of the electron, proton, and neutron.

- relate the mass number and atomic number to the structure of each atom.

- list differences among the isotooes of a particular element.

- write the symbol for the more common elements with its atomic number and mass number.

- that modern concepts of atomic structure have evolved and continue to evolve as new experimental information is presented.	- discuss the relationship between the energy lev Bohr model and the observed spectrum of hydroge
	- list the four quantum numbers and describe prop the energy levels that they convey.
	- write the electron configuration notation for t with atomic numbers 1-20.
	- draw the orbital notation for the elements with numbers 1-20.
	- reproduce an electron-dot diagram for any given
	- explain how the properties and electronic struc atoms are related to the ionization energies, e affinities, and electronegativities.
	- observe and discuss the difference in the line several elements.
- that the source of radioactivity and atomic energy is the nucleus of the atom.	- distinguish between alpha, beta, and gamma radia
	- write balanced equations to show the radioactive
	- perform simple calculations based on the half-li radioisotope.
	- use a geiger counter or a cloud chamber to detec radiation.
- a chemical bond results from the simultaneous attraction of electrons to two nuclei.	- relate energy changes to exothermic and endother reactions.
	- predict the stability of a compound from heat of
- chemical changes will occur among atoms if the changes lead to a lower energy condition and hence a more stable structure.	- predict the tendency of an element to react base ionization energy.

omic structure
to evolve as
on is presented.

- discuss the relationship between the energy levels in the Bohr model and the observed spectrum of hydrogen.
- list the four quantum numbers and describe properties of the energy levels that they convey.
- write the electron configuration notation for the elements with atomic numbers 1-20.
- draw the orbital notation for the elements with atomic numbers 1-20.
- reproduce an electron-dot diagram for any given element.
- explain how the properties and electronic structure of atoms are related to the ionization energies, electron affinities, and electronegativities.
- observe and discuss the difference in the line spectra of several elements.

ivity and
s of the

- distinguish between alpha, beta, and gamma radiation.
- write balanced equations to show the radioactive processes.
- perform simple calculations based on the half-life of a radioisotope.
- use a geiger counter or a cloud chamber to detect radiation.

n the simul-
rons to two

- relate energy changes to exothermic and endothermic reactions.
- predict the stability of a compound from heat of formation.

among atoms if
energy condition
ucture.

- predict the tendency of an element to react based on its ionization energy.

	- predict the tendency of an element to react bas electron affinity.
- the electrons involved in bond formation many be transferred from one atom to another, or may be shared equally or unequally between two atoms.	- describe and explain the tendency of an atom to their maximum complement of valence electrons. - distinguish between ionic, covalent, and metall and characteristics of each type of bond. - differentiate electronic configuration of an at ion and make drawings of each. - draw and interpert electron dot diagrams. - use electronegitivity difference to determine t character of a bond. - distinguish between polar and nonpolar substanc
- groups of atoms covalently bonded in a molecule may be attracted to similar molecules or to ions.	- recognize and explain the distribution of charg gives rise to a dipole unit. - explain the nature of the hydrogen bond. - describe and explain van der waal's forces. - relate van der wall's forces to increasing boil of a series of similar compounds. - explain the solubility of compounds in polar or solvents.
- a chemical formula is both a qualitative and a quantitative expression of the composition of an element or a compound.	- recognize and write symbols for the elements. - distinguish and write molecular and empirical f - use traditional nomenclature to name acides, ba salts.

- predict the tendency of an element to react based on its electron affinity.

nd formation
atom to
ually or

- describe and explain the tendency of an atom to obtain their maximum complement of valence electrons.
- distinguish between ionic, covalent, and metallic bonding and characteristics of each type of bond.
- differentiate electronic configuration of an atom from its ion and make drawings of each.
- draw and interpert electron dot diagrams.
- use electronegitivity difference to determine the ionic character of a bond.
- distinguish between polar and nonpolar substances.

onded in a
similar

- recognize and explain the distribution of charge which gives rise to a dipole unit.
- explain the nature of the hydrogen bond.
- describe and explain van der waal's forces.
- relate van der wall's forces to increasing boiling points of a series of similar compounds.
- explain the solubility of compounds in polar or nonpolar solvents.

qualitative
n of the com-
compound.

- recognize and write symbols for the elements.
- distinguish and write molecular and empirical formulas.
- use traditional nomenclature to name acides, bases, and salts.

- that the periodic table has progressed through many different stages. However, the periodic table today is based on atomic number and properties.

- that the periodic table can be used as a means of determining the properties and characteristics of elements.

- that the column is a relationship among the elements of a given group (family)

- list oxidation numbers for elements.

- write and balance a simple equation.

- name and explain the basis of the three forerun modern periodic table.

- diagram and explain the reasons for the present of the elements in the periodic table.

- identify groups and series on the periodic tabl

- explain the trends within a given period or gro

- graph the atomic radii of elements verses atomi

- approximate the ionic radius of an element from in the periodic table.

- identify the positions of metals, nonmetals, an on the periodic table.

- graph the ionization energy verses atomic numbe

- graph the electron affinity verses atomic numbe

- list the general characteristics of metals, non metalloids.

- determine the number of valence electrons commo in a given group.

- list the general properties and characteristics group, more specifically one of the "A" groups tative elements).

- list and explain the properties of a group of t elements.

- list oxidation numbers for elements.

- write and balance a simple equation.

as progressed
ages. However,
is based on atomic

- name and explain the basis of the three forerunners of the modern periodic table.

- diagram and explain the reasons for the present arrangement of the elements in the periodic table.

an be used as a
properties and
nts.

- identify groups and series on the periodic table.

- explain the trends within a given period or group.

- graph the atomic radii of elements verses atomic numbers.

- approximate the ionic radius of an element from its position in the periodic table.

- identify the positions of metals, nonmetals, and metalloids on the periodic table.

- graph the ionization energy verses atomic number.

- graph the electron affinity verses atomic number.

- list the general characteristics of metals, nonmetals, and metalloids.

tionship among
roup (famil.)

- determine the number of valence electrons common to elements in a given group.

- list the general properties and characteristics of a given group, more specifically one of the "A" groups (representative elements).

- list and explain the properties of a group of transition elements.

- list and explain the properties of the Group 0 el

- as a period is observed from left to right, a study of the elements leads to certain generalizations pertaining to size, ionization energies, oxidation states, valence and metallic characteristics.

- list and explain the trends within a given perio of the following:
  - radii.
  - ionization energies.
  - electronegativities.
  - oxidation states.
  - valence electrons (dot formulas).
  - metallic characteristics.

- that there are two (2) special series of transition elements.

- list and describe the two special series of el giving the following:
  - atomic numbers of elements in each.
  - how they differ from other transitions element
  - importance of series.

- identify the major energy level in which electro filling in for the particular transition series.

- list the variable possible valances that a part transition element may have.

- that the rate of a chemical reaction depends upon many factors as well as the change in the energy of the system.

- determine the rate of a chemical reaction.

- calculate the heat of reaction for a chemical r

- predict the affect on the rate of a chemical re a change in concentration takes place.

- predict the affect on the rate of a chemical re when a change in temperature takes place.

- predict the affect on the rate of a chemical re when a catalyst is added.

- predict the affect on the rate of a chemical re the reaction mechanism is know.

- list and explain the properties of the Group 0 elements.

rom left to right,
ads to certain
to size, ionization
, valence and

- list and explain the trends within a given period of each of the following:
  - radii.
  - ionization energies.
  - electronegativities.
  - oxidation states.
  - valence electrons (dot formulas).
  - metallic characteristics.

ecial series of

- list and describe the two special series of elements giving the following:
  - atomic numbers of elements in each.
  - how they differ from other transitions elements.
  - importance of series.

- identify the major energy level in which electrons are filling in for the particular transition series.

- list the variable possible valances that a particular transition element may have.

al reaction depends
as the change in

- determine the rate of a chemical reaction.

- calculate the heat of reaction for a chemical reaction.

- predict the affect on the rate of a chemical reaction when a change in concentration takes place.

- predict the affect on the rate of a chemical reaction when a change in temperature takes place.

- predict the affect on the rate of a chemical reaction when a catalyst is added.

- predict the affect on the rate of a chemical reaction when the reaction mechanism is know.

- that the rates of change of some chemical reactions are equal in the opposite directions and these rates can be changed by various factors.	- list the different types of equilibrium systems - apply Le Chatelier's principle with respect to different equilibrium systems. - predict the change in rates with a change in co - predict the change in the rate with a change in - predict the change in the rate with a change in - predict the change in the rate with the additio catalyst. - formulate the equilibrium expression from the equation. - predict the strength of an acid or base from t of the equilibrium constant. - predict the solubility of a substance by the m the solubility product constant.
- that chemical reactions take place spontaneoulsy when there is an energy loss and entropy gain in the chemical system.	- determine the energy change within a given che - determine the entropy change within a given ch reaction. - predict if a chemical reaction takes place spo from the value of the free energy of the chemi - predict the stability of a compound from its h formation.
- that an electrolyte is a solution composed of ions.	- list specific examples of electrolytes: ionic and acids. - state the factors which affect boiling and fre

of some chemical he opposite dir- can be changed by	- list the different types of equilibrium systems.
	- apply Le Chatelier's principle with respect to the different equilibrium systems.
	- predict the change in rates with a change in concentration.
	- predict the change in the rate with a change in temperature.
	- predict the change in the rate with a change in pressure.
	- predict the change in the rate with the addition of a catalyst.
	- formulate the equilibrium expression from the chemical equation.
	- predict the strength of an acid or base from the magnitude of the equilibrium constant.
	- predict the solubility of a substance by the magnitude of the solubility product constant.
ake place spontaneoulsy	- determine the energy change within a given chemical reaction.
oss and entropy gain	- determine the entropy change within a given chemical reaction.
	- predict if a chemical reaction takes place spontaneously from the value of the free energy of the chemical reaction.
	- predict the stability of a compound from its heat of formation.
solution composed	- list specific examples of electrolytes: ionic compounds and acids.
	- state the factors which affect boiling and freezing points.

- that solutions may be classified as acids or bases. Each having their own characteristic properties.	- list the characteristic properties of acids. - state the Arrhenius and Bronsted-Lowry definitio acids, and use a reaction to show each. - list the characteristic properties of bases. - use the Arrhenius and Bronsted-Lowry theories to examples of a base. - define and give an example of an amphoteric subs the help of chart-H on the periodic table-handou
- acid-base neutralization pertains to the reaction which occurs when equivalent quantities of an acid and a hydroxide are mixed.	- determine the concentration of an acid or base. the titration method and the titration formula, the concentration of an acid. - predict the salt formed from an acid-base reacti - determine acids, bases, conjugate acids and conj in a given reaction. - defins and give an example of a buffer.
- that the degree of ionization of an acid will determine the concentration of the solution.	- determine the strongest acid and the weakest aci list containing their ionization constant. - calculate the hydronium ion concentration of a s using the ionization constant of water. - calculate the PH and the POH of a solution. - calculate the hydronium ion concentration from p - write the expression used to find ph. - determine the ph of a solution by using hydrion - solve molarity problems.

sified as acids
ir own character-

- list the characteristic properties of acids.
- state the Arrhenius and Bronsted-Lowry definitions of acids, and use a reaction to show each.
- list the characteristic properties of bases.
- use the Arrhenius and Bronsted-Lowry theories to give examples of a base.
- define and give an example of an amphoteric substance with the help of chart-H on the periodic table-handout.

ertains to the
equivalent
a hydroxide

- determine the concentration of an acid or base. Using the titration method and the titration formula, determine the concentration of an acid.
- predict the salt formed from an acid-base reaction.
- determine acids, bases, conjugate acids and conjugate bases in a given reaction.
- defins and give an example of a buffer.

ion of an acid
ration of the

- determine the strongest acid and the weakest acid from a list containing their ionization constant.
- calculate the hydronium ion concentration of a solution using the ionization constant of water.
- calculate the PH and the POH of a solution.
- calculate the hydronium ion concentration from ph.
- write the expression used to find ph.
- determine the ph of a solution by using hydrion paper.
- solve molarity problems.

- that the oxidation-reduction reactions result from the competition between atoms for electrons.	- determine the oxidation numbers of the atoms of in a compound by applying the rules of assignin numbers.
	- identify the element which undergoes the proces oxidation by the change in the oxidation state.
	- identify the element which undergoes the proces reduction by the change in the oxidation state.
	- determine the number of electrons lost by the r and the number of electrons gained by the oxidi
- that the proper arrangement of an oxidizing agent and a reducing agent can result in the production of electricity by a chemical reaction,	- identify a half-cell reaction which involves ox
	- identify a half-cell reaction which involves re
	- determine the total cell potential from the cou two half-cells.
	- determine if the oxidation-reduction reaction w spontaneous by the sign of the cell potential.
	- determine under what conditions an electrochemi will have a total potential of zero.
- that in an electrolytic cell oxidation and reduction reactions can be forced to take place by supplying electrical energy from an external source.	- determine the oxidation reaction which takes pl positive electrode in a given electrolytic cell
	- determine the reduction reaction which takes pl negative electrode in a given electrolytic cell
	- draw a diagram to show the operation of a parti electrolytic cell.
- that the balancing of difficult equations can be done more easily by using the oxidation and reduction method to balance.	- write the oxidation equation.
	- write the reduction equation.

ion reactions on between	- determine the oxidation numbers of the atoms of elements in a compound by applying the rules of assigning oxidation numbers.
	- identify the element which undergoes the process of oxidation by the change in the oxidation state.
	- identify the element which undergoes the process of reduction by the change in the oxidation state.
	- determine the number of electrons lost by the reducing agent and the number of electrons gained by the oxidizing agent.
nt of an oxidizing t can result in city by a chemical	- identify a half-cell reaction which involves oxidation.
	- identify a half-cell reaction which involves reduction.
	- determine the total cell potential from the coupling of two half-cells.
	- determine if the oxidation-reduction reaction will be spontaneous by the sign of the cell potential.
	- determine under what conditions an electrochemical cell will have a total potential of zero.
ell oxidation and e forced to take ical energy from	- determine the oxidation reaction which takes place at the positive electrode in a given electrolytic cell.
	- determine the reduction reaction which takes place at the negative electrode in a given electrolytic cell.
	- draw a diagram to show the operation of a particulzr electrolytic cell.
ficult equations using the ox- od to balance.	- write the oxidation equation.
	- write the reduction equation.

	- balance the oxidation equation and the reductio equation so that the number of electrons lost e the number of electrons gained.
	- balance the general equation by using coefficie attained from the balancing of the oxidation eq and the reduction equation.
- that the large number of organic compounds results from the unique ability of carbon to form stable bonds with itself as well as with other elements.	- recognize the difference between an organic and inorganic compound.
	- draw the carbon tetrahedron.
	- list the general properties of organic compound contrast them with those of inorganic compounds
	- distinguish between saturated and unsaturated m
- that the large number and diversity of carbon compounds necessitates a logical system of classification and nomenclature.	- recognize the different classes of carbon compo upon structural differences.
	- name and write formulas for the simple hydrocar
	- make ball-and-stick models of the simple hydroc compounds.
	- draw the structure of a given member of a homol of hydrocarbons.
	- discuss the sources and uses of some important
- that a large number of derivatives are possible by modifying hydrocarbon molecules.	- write structures for and name some of the more organic derivates in the following classes: - halides - alcohols - aldehydes - acids - amines - ethers - esters - ketones

- balance the oxidation equation and the reduction equation so that the number of electrons lost equal the number of electrons gained.

- balance the general equation by using coefficients attained from the balancing of the oxidation equation and the reduction equation.

rganic compounds
ility of carbon
itself as well as

- recognize the difference between an organic and an inorganic compound.

- draw the carbon tetrahedron.

- list the general properties of organic compounds and contrast them with those of inorganic compounds.

- distinguish between saturated and unsaturated mol ecules.

iversity of carbon
ogical system of
ture.

- recognize the different classes of carbon compounds based upon structural differences.

- name and write formulas for the simple hydrocarbon compounds

- make ball-and-stick models of the simple hydrocarbon compounds.

- draw the structure of a given member of a homologous series of hydrocarbons.

- discuss the sources and uses of some important hydrocarbons.

vatives are
carbon molecules.

- write structures for and name some of the more common organic derivates in the following classes:
  - halides
  - alcohols
  - aldehydes
  - acids
  - amines
  - ethers
  - esters
  - ketones

- that many organic compounds can be formed by a few common reactions.

- the relationship of chemistry and physics to the study of living things.

- investigate experimentally some simple addition substitution reactions.

- prepare some simple esters from acids and alcoh

- prepare a complex organic compound and check it by determing its melting point.

- observe (or preform) the polymerization of a pl

- observe a fermentation reaction.

- seperate a mixture of organic liquids by distil

- write correctly balanced equations for simple o reactions.

- identify the products and explain their uses fr following reactions:

  - fermentation
  - substitution
  - saponification
  - esterification
  - polimerization
  - addition

- diagram the atomic structure of the elements us Bohr Model of the atom.

- compare and contrast covalent, ionic, and dydro

- describe free energy change and entropy.

- compare and contrast carbohydrates, lipids, and

- recognize the functional groups: methylk, hydr carboxyl, carbonyl-keto and aldo, suffhydryl, a

nds can be formed
.

- investigate experimentally some simple addition and substitution reactions.

- prepare some simple esters from acids and alcohols.

- prepare a complex organic compound and check its purity by determing its melting point.

- observe (or preform) the polymerization of a plastic.

- observe a fermentation reaction.

- seperate a mixture of organic liquids by distillation.

- write correctly balanced equations for simple organic reactions.

- identify the products and explain their uses from the following reactions:

  - fermentation
  - substitution
  - saponification
  - esterification
  - polimerization
  - addition

stry and
iving things.

- diagram the atomic structure of the elements using the Bohr Model of the atom.

- compare and contrast covalent, ionic, and dydrogen bonds.

- describe free energy change and entropy.

- compare and contrast carbohydrates, lipids, and proteins.

- recognize the functional groups: methylk, hydroxyl, carboxyl, carbonyl-keto and aldo, suffhydryl, amino, etc.

- the role of enzymes in nature.

- identify the molecular structure of carbohydrat
  acids, lipids, amino acids, nucleotides, porphy
- identify the 2 dimensional and 3 dimensional st
  proteins and the double helix model.
- compute problems showing knowledge of concepts
  stoichiometry and chemical equilibria.
- definecatalysts and catalysis.
- describe the enzyme - substrate complex and hov
  work.
- compare and contrast competitive and noncompeti
  inhibitors.
- list the factors affecting the rate and/or dire
  of enzyme reactions.
- compare and contrast enzymes and coenzymes.
- describe the enzyme "lock & key" hypothesis.
- define and give examples of inorganic cofactor
  prosthetic groups.

- identify the molecular structure of carbohydrates organic acids, lipids, amino acids, nucleotides, porphyrins.

- identify the 2 dimensional and 3 dimensional structure of proteins and the double helix model.

- compute problems showing knowledge of concepts of stoichiometry and chemical equilibria.

ture.

- definecatalysts and catalysis.

- describe the enzyme - substrate complex and how enzymes work.

- compare and contrast competitive and noncompotitive inhibitors.

- list the factors affecting the rate and/or direction of enzyme reactions.

- compare and contrast enzymes and coenzymes.

- describe the enzyme "lock & key" hypothesis.

- define and give examples of inorganic cofactors, and prosthetic groups.